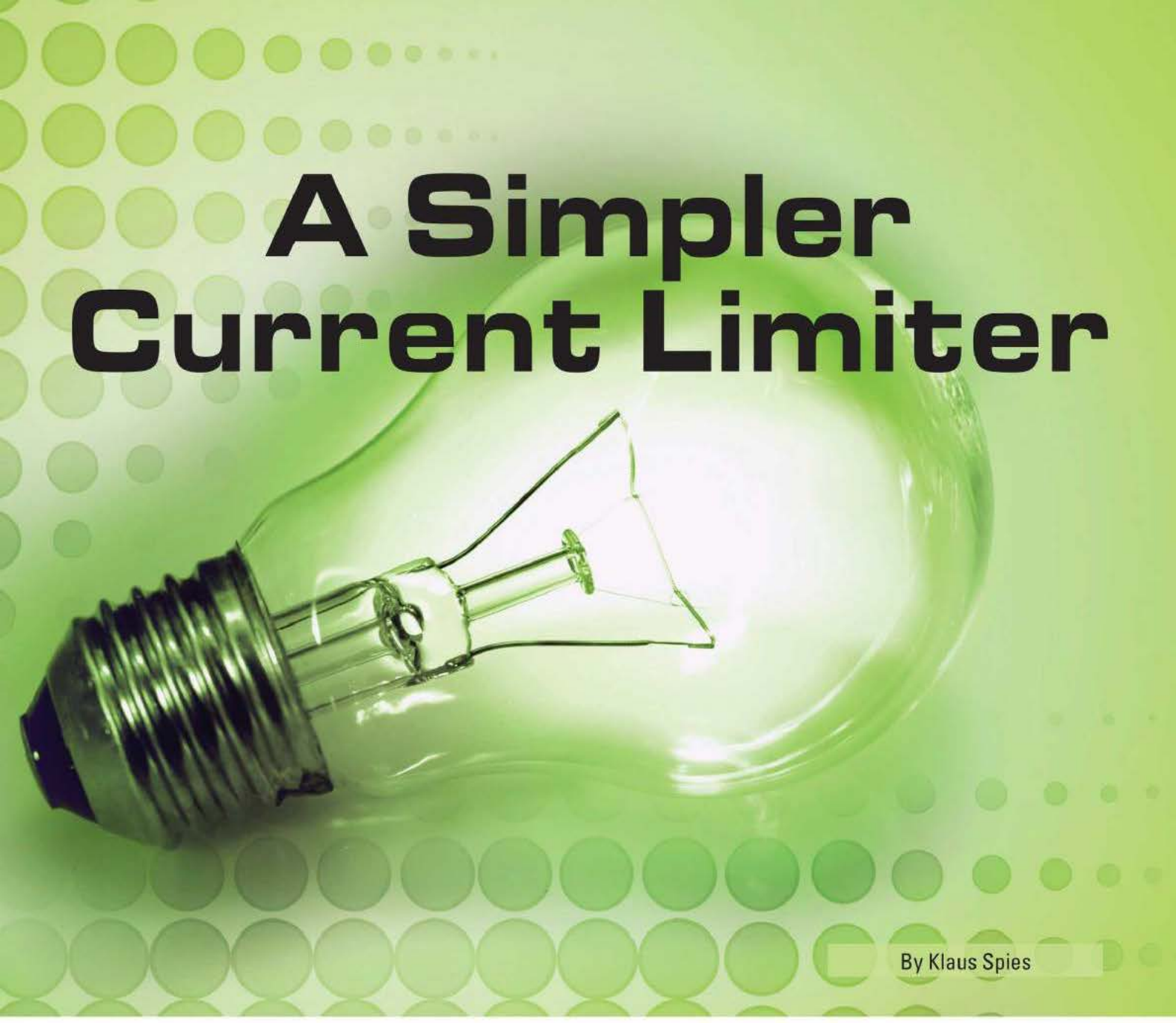
A Simpler Current Limiter



By Klaus Spies

There are certain instances when current must be limited into a circuit regardless of voltage variations. One example of this is charging batteries. As a battery's voltage increases during its charging cycle, the current from the charger must stay fixed as determined by the charge rate of the battery (or battery pack).

Another useful application for limiting current regardless of the load is when trouble-shooting a short or near-short in a circuit. Current must be limited to levels below which printed circuit board (PCB) traces, fuses, wires, etc., burn out while removing parts suspected of causing the short or near-short.

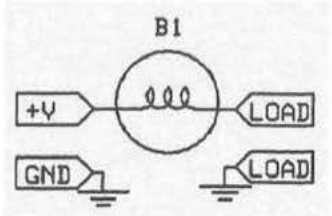
While there are several approaches to limiting the supply of current using active circuitry, there is a much simpler approach using passive components; specifically, light bulbs.

When hooked directly across a power source, the light bulb will glow at maximum brightness and the current through the circuit will be limited by the current rating of that bulb; as voltage levels are lowered, it gets less bright. As long as its specified voltage rating is not exceeded, it will not burn out.

If we hook a light bulb between a power source and (for example) a battery, the battery will get charged at a current limited by the bulb regardless of the charge level (and therefore voltage level) of the battery. The only thing to consider is the maximum voltage and desired permissible maximum allowable current we need for a given application (refer to **Schematic 1**; also reference the charts included with the article downloads).

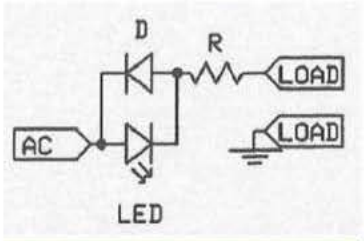
If different maximum current levels are required, there are a few options. First, select the current capability of a bulb per the available charts, then pick a bulb at or below the maximum allowable current.

Hook the bulb between the power source and the load, and current will be limited to the rating of the bulb (**Schematic 1**).



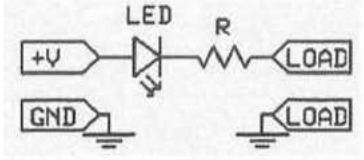
SCHEMATIC 1.

Schematic 2 shows a method to select other bulbs via single SPST switches; the bulbs can either all be the same type so that current can be increased in identical increments or different bulbs can be used in each position to represent different current requirements. Or, the bulbs can be selected where the current they pass isn't the same as is needed by the circuit and therefore are wired in parallel to come out where needed.



SCHEMATIC 3.

If different bulbs are used in each position, a single rotary switch can be substituted for multiple SPST switches to select individual (instead of multiple) bulbs. Or, bulbs of a single current rating can be used for identical incremental steps of current.



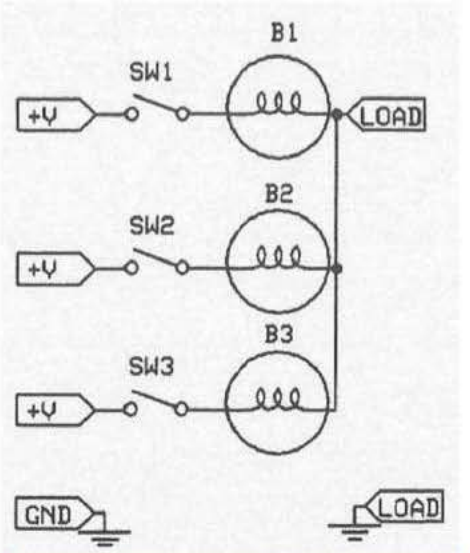
SCHEMATIC 4.

The benefit of using light bulbs is that they can be used for either AC or DC circuits.

However, here are a few cautions to observe in their use:

- Operating voltages can vary quite a bit since they are used for everything from single battery flashlights (like pen lights) to household lights.
- Regular incandescent bulbs generate heat.
- They have limited life span.

There's nothing much that can be done about their limited life span unless we go with LEDs, and heat is only a concern for higher wattage lights (like automotive or household bulbs), although we do have a bit of control regarding operating voltages.



SCHEMATIC 2.

For example, if our supply voltage is 12 volts (typical of ham shacks) and the only bulbs available for the current rating we need are six volts, we simply put two six volt bulbs in series.

Just like two resistors of equal value when placed in series across a voltage source, each will drop half of the supply voltage. (More than two bulbs will work, too!)

The advantage of light bulbs is that they come in multiple ratings (both voltage and current), so almost any value of voltage and current limiting can be accomplished (again, refer to the charts included in the downloads).

LEDs can also be used as current limiters, but with slightly different requirements.

For example, since LEDs are not designed to withstand as much reverse voltage as regular diodes (especially the rectifier types), they must be protected from higher reverse voltages by a stronger (i.e., rectifier) diode (**Schematic 3**). The resistor shown must be chosen for the maximum ratings of the LED (typically 20 mA forward current and 2V drop across the LED, depending on which type you choose).

For DC applications, LEDs operate just like the light bulbs discussed earlier (see **Schematics 4** and **5**), except that they are polarity-sensitive and must be forward-biased to operate.

Part numbers and ratings have intentionally not been specified so that the user can customize part values

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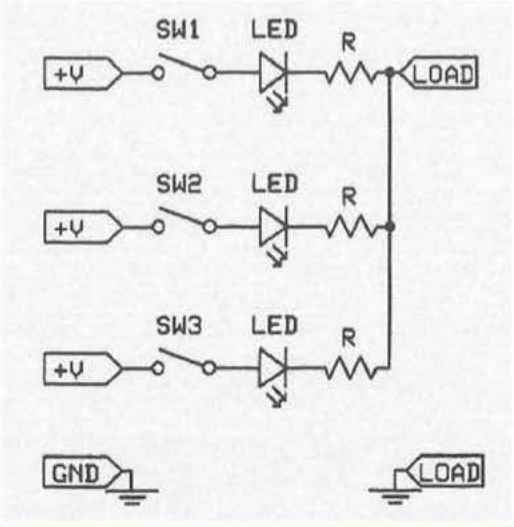
depending on the application(s) and which parts are available in their parts bins.

There are a few recommendations, however:

- Always make sure that components are able to handle the amount of current being used – proper wire gauge, switch ratings, etc.
- For ease and safety of operation, never just leave the lights and switches just flopping around. Mount everything into its own enclosure, or as a minimum onto a panel on your test bench.
- Be aware of operating conditions. For example, if you're dealing with higher currents requiring high-current lights like those found in automotive applications or high intensity bulbs like xenon, be aware that these bulbs get hot; keep them away from anything flammable. In the case of very bright lights that can cause eye damage, consider putting some kind of shield over that bulb. Since many bulbs are enclosed in glass, be aware of the dangers of glass if/when it should break.



SCHEMATIC 5.

Conclusion

Which of the aforementioned current limiter ideas is best to use? Why isn't there just a single schematic for such a project? Both questions can be answered the same way: It depends on your application.

That's why different approaches have been discussed; so that the basic principles that have been presented can be used in a variety of circumstances, meeting the need of the user's given application. **NV**

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